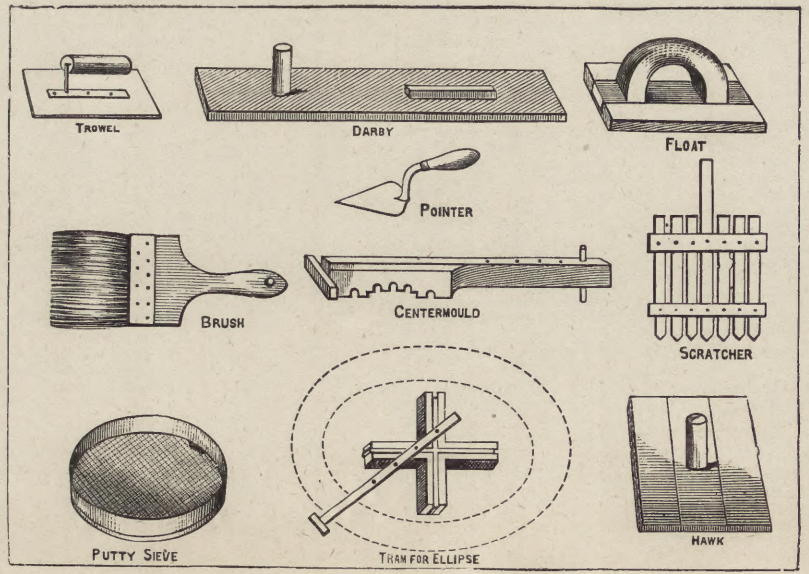
# CAMERON'S
# PLASTERER'S MANUAL.

John C. Trautwine Jr.

Oct 26/87.


TROWEL
DARBY
FLOAT
POINTER
BRUSH
CENTERMOULD
SCRATCHER
PUTTY SIEVE
TRAM FOR ELLIPSE
HAWK

CAMERON'S

# PLASTERER'S MANUAL.

REVISED EDITION.

CONTAINING

ACCURATE DESCRIPTIONS OF TOOLS AND MATERIALS USED IN PLASTERING;
DESCRIPTION OF THE APPEARANCE AND ACTION OF THE VARIOUS LIMES AND CEMENTS;
INSTRUCTIONS FOR MAKING MORTAR, AND FOR DOING ALL KINDS OF PLASTERING;
CISTERN BUILDING; FORM OF CONTRACT;
USEFUL TABLES AND RECIPES;
IMPORTANT SUGGESTIONS, CAUTIONS ETC.
WITH ILLUSTRATIONS.



BY K. CAMERON.

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6 ASTOR PLACE.
1883.

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6—CISTERNS, *Continued.*



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# INTRODUCTORY.

In consideration of the general favor with which the Plasterer's Manual has been received, during the three or four years since its publication, it has been decided to issue a new and revised edition of the work.

This revised edition contains all that was in the former edition, with the misprints and omissions corrected; also new illustrations and additional recipes, etc. with an entirely new chapter on practical suggestions and precautions.

The original intention of the author, which was to give as much practical information as possible in the least space, is carried out in the revised edition. In the following pages the novice will find all necessary instructions, and the experienced numerous recipes, tables of reference &c. of value. Again we would say to the beginner: Do not depend upon a book alone in learning the trade; example and practice, as well as precept, are also required to master it thoroughly. It is therefore essential, to place yourself under the instruction of an experi-

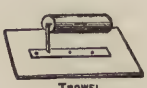
enced workman, being careful to form the apprenticeship only with one whose work and reputation are excellent. An apprenticeship formed with any other will prove a damage rather than a help.

The author presents this new edition to the public, hoping that it will fulfil its purpose more completely than former editions.

The book is intentionally small and condensed, in order that it may be conveniently carried in the pocket and be constantly useful, and at the same time published at a low price.

## CHAPTER I.

### TOOLS USED.



TROWEL.

**The Trowel**—Is the tool which is most used by plasterers; and should be selected with care. It should be made of the best steel, light, springy, and about four and one-half inches wide by twelve inches long, with a good wooden handle fastened on tightly enough to prevent its turning on the shank.

HAWK

**The Hawk**—Is generally made of hard pine; is thirteen or fourteen inches square, about one-fourth of an inch thick at the edges, and three-fourths of an inch thick in the middle, with a cleat nicely dovetailed into the back to prevent warping. The handle is five, or five and one-half inches in length, and one and one-fourth, to one and one-half inches in diameter.

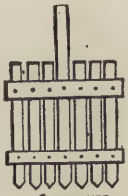
DARBY

**The Darby**—Is also made of hard pine, three feet, four inches long, by four inches wide, with two handles one similar to the hawk handle, fastened on at about one-fourth of the length from one end, the other being a narrow strip fastened with one edge flat on the darby and running lengthwise of it. This strip is generally about eight inches long, but some plasterers prefer to have it extend nearly the whole length for the purpose of stiftening the darby; the length however may be varied to suit the workman using it, or the nature of the work to be done. The darby is usually made of half inch stuff.

FLOAT

**The Float**—Is composed of a piece of hard pine board four or five inches wide by ten or twelve inches long, and about three fourths of an inch thick, with a good wooden handle on the back. As the face of a float soon wears off and becomes thin, it is best to fasten the handle to cleat, and dovetail the cleat into the back of the face-piece, as shown in the above cut. It would be well to have several face-pieces on hand, so that as soon as one

becomes worn, a new one may be substituted. The face-piece of a float should always be kept perfectly true.



SCRATCHER

**The Scratcher**—is made of short slats nailed to two cross-pieces, and sharpened at one end. The slats are placed about one inch apart, and the width of the scratcher is usually one foot. The middle slat should be long enough so that the opposite end from the point can be used as a handle.

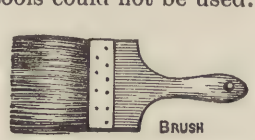
**The Straight-edge**—Is pine, six feet and upward in length, and consists of a face-piece two and one-half inches wide, nailed on the edge of a back-piece five inches wide in the middle and tapering to one inch at each end, and is generally made of three-fourths inch stuff.

**The Long Rod**—Is a long straight-edge made of a planed pine board generally six inches wide and one inch thick, with a length nearly equal to the height of the rooms in which it is to be used. These rods are often made with a spirit plumb inserted like the plumb in a spirit level.

**The Angle Block**—Is used by many plasterers, and consists simply of a block of wood from ten to fourteen inches in length and three inches in thickness with its angles right angles, and a handle on the opposite angle from the one which is to touch the angle of the wall. The handle and the block are generally made in one piece. Most plasterers use a good square edged float instead of the angle-block

POINTER

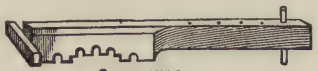
**The Pointer**—Is a small, pointed trowel, the same shape as a brick trowel, with a blade of good springy steel, four or five inches long. It is used by plasterers, principally to clean tools, and to work where larger tools could not be used.



BRUSH

**The Plasterer's Brush**—Is a kalsomine brush seven or eight inches wide, made of good bristles bound with zinc or other metal: and the wood between the two halves of the bristles should be shaved to a thin edge, so that water will not collect in the brush and run out as soon as it is inverted. The handle is short and permanently fixed in the head of the brush.

**The Paddle**—Is a small, flat wooden tool used by some workmen to fill the angles while finishing. It is about five inches long, and two or two and one-half inches wide with one end sharpened to an edge and the other end used as a handle.

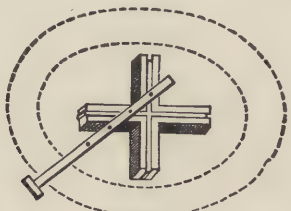


CENTERMOULD

**Moulds**—Are of a variety of kinds; moulds for full relief ornaments are generally made in sections and put together leaving an orifice into which to pour the plaster. Moulds for bas-reliefs are made in one piece usually. They are made of Plaster of Paris and glue or shellac, or bees-wax. Moulds for linear mouldings are made of metal plates cut to fit the mouldings desired, and fastened to wooden backings for the purpose of stiffening the moulds. Center moulds of this kind are attached to an arm and swing on a pivot. Cornice moulds of the same description are made with shoes to slide on strips and screeds, and the blade or cutting piece can be set into the head-piece at an angle of forty-five degrees so that it will run into the angle and make the mitre. These are called mitre moulds, and they run much easier than the old fashioned square moulds that run at right angles to the moulding.

**Mitring Tools**—Are used to make mitres by hand where they cannot be easily made with the

mould; and also to finish out breaks or balks in the mouldings where the mould is taken off etc. They consist of a number of steel and wooden tools of a variety of shapes and sizes, among which is the mitring rod, a flat tool about one-eighth of an inch thick, three inches wide and about one foot long, with one edge sharp and one end beveled to an angle of about thirty degrees; the acute angle being at the sharp edge.



TRAM FOR ELLIPSE

**Trammels**—Are used to attach moulds to, for the purpose of running mouldings in the form of ellipses, arches, and curves generally; they are made according to the particular use for which they are required.

**The Mortar Hod**—Is made by nailing together two boards about one foot wide by two and one-half feet long, at right angles, forming a trough-shaped box; a triangular piece of board is then nailed on one end, and the boards are beveled or rounded toward the angle at the other end. Then the handle is attached a little forward of the middle and a

flat block, or a pad, is placed just behind the handle, to rest on the shoulder of the carrier.

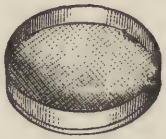
**Scaffolds**—For plasterers use are generally made with horses of height and length to correspond with the rooms to be plastered, and covered with planks. For very high apartments, such as churches etc. it is customary to make temporary scaffolds by placing scantlings on end for standards, and nailing cross-pieces or stringers to them for the planks to rest upon. The standards should be well braced to prevent their falling over or bending.

**Mortar Boards**—Are made about three and one-half feet square, of boards one inch thick, with close joints. The boards are nailed upon two solid cleats which are put far enough apart to admit the head of a barrel between them as the board is often placed upon a barrel when used. Boards used for finishing are frequently made larger than ordinary mortar-boards.

**Mortar Beds**—Are usually made of boards, and of size and shape to suit circumstances, but not more than one or two feet deep. The sides and ends should be strongly fastened together, as they have to sustain a heavy pressure.

**The Sand Screen**—Is a long, narrow screen, about two feet wide by six feet long, and when used is set at an angle of about forty-five degrees, (more

or less, according to the dampness of the sand) The sand thrown against it, sifts through as it slides down.



PUTTY SIEVE

**The Putty Sieve**—The putty for finishing can be strained through an ordinary flour or meal sieve. One of any desired size may be obtained by making a box with a fine screen for the bottom.

## CHAPTER II.

### MATERIALS USED.

**Lime and Hydraulic Cement**—Lime, such as we use for ordinary building purposes, is obtained by calcining, or burning, calcareous minerals, that is common limestone, or carbonate of lime, which is deprived of the carbonic acid and water contained in it, by heat, and becomes lime. Limestone which is pure, or nearly so, supports a white heat without detriment. The compound limestone, on the other hand, alloyed in the proportions to form hydraulic lime, fuses easily, and its calcination demands certain precautions. The heat should never be pushed beyond the common red heat,—the intensity being compensated for by its longer duration;—except in the manufacture of Portland Cement from argillaceous limestone containing from twenty to twenty-two per cent. of clay; when a heat of great intensity, as well as of long duration is required.

The compound limestone, when too much burnt, is heavy, compact, dark colored, and covered with a kind of enamel, especially about the angular parts. It slacks with great difficulty, and yields a lime carbonized and without energy. Sometimes it will not slack at all, but becomes reduced, after

some days, to a harsh powder altogether inert. Both the pure and compound limestones, when insufficiently burnt, either refuse to slack, or slack only partially, leaving a solid kernel—a kind of subcarbonate with excess of base.

The characteristics of the various kinds and qualities of limes are as follows:

1st. The *rich limes* are the purest metallic oxides of calcium we possess, and the purer the carbonate of lime from which they are obtained the more distinctly marked are the appearances from which they derive their name These are that they increase in volume to twice their orginal bulk, or even more, when slacked in the usual manner: and that they will not set under water, if not mixed with some other material, even though left immersed for years.

2nd. The poor *limes* are those which do not increase in bulk at all or only to a trifling degree, when slacked. They do not set under water any more than the rich limes.

3rd. The *moderately hydraulic limes* set under water in from fifteen to twenty days, but do not become very hard. The change in bulk which they undergo in slacking is the same as that of the poor limes, but never equal to that of the rich varieties.

4th. The *hydraulic limes* set in from six to eight days immersion and continue to harden for some months.

5th. The *eminently hydraulic limes* set within three or four days, or less, and become quite hard in a month.

**Classification of the Rocks with Reference to Chemical examination.**

1st. Pure calcareous rocks, or those containing from one to six per cent. of silex, alumina, (common clay), magnesia, iron, etc., either separately or in combination, give rich limes upon being calcined.

2nd. The limestone containing soluble silica in the state of sand, magnesia, the oxides of iron and of mangnese, in varying quantities, but limited to between fifteen and thirty per cent. of the whole mass, yields poor limes.

3rd. The limestone containing silica in combination with alumina, magnesia and traces of oxides of iron and manganese, in varying proportions, but within the limits of from eight to ten per cent. of the whole mass, yield moderately hydraulic limes.

4th. When the above ingredients are present in the proportion of from fifteen to eighteen per cent., but the silica in its soluble form always predominating, the limestone yields an hydraulic lime.

5th. When the limestone contains more than twenty and up to thirty per cent. of the above ingredients, but with the soluble silica in the proportion of at least half of them, the limestone yields eminently hydraulic lime.

The experiments upon which the above conclusions are based appear to show that limes owe their hydraulicity, or power to set under water, to the presence of a certain quantity of clay, and sometimes to the presence of a certain quantity of pure, soluble silica; and upon that principle a large proportion of our hydraulic cement is manufactured by mixing common fresh burnt lime, with burnt clay, and grinding them together, generally in the proportions of twenty parts of clay to thirty parts of rich lime, but the proportions vary with the quality of the limestones and clays found in different localities.

Limestone suitable for the manufacture of Portland Cement seems to be a rather scarce article in most parts of the United States. Rosendale Cement is manufactured in several localities.

The dark colored cements, as a rule, are stronger than the light colored.

Practically speaking the best quick-lime for ordinary plastering, and especially finishing, is white or nearly so, when slacked; slacks readily, but has not too much energy. Such lime generally makes the hardest plastering, works cooler, is not so apt to crack, and bears trowelling without peeling or blistering when finishing, and is less liable to stain with trowelling than some of the poorer limes.

**Calcined Plaster.**—Gypsum plaster ground fine, calcined and sifted finely, is the plaster used for hard

finish, stucco work, etc. White or bluish white is the best color for general use. It is commonly known as "Plaster of Paris."

**Sand.**—Sands are derived, originally, from the decomposition of the older rocks, either by the action of running waters, or by the spontaneous decomposition of the rocks themselves. They are technically distinguished from dust, by the fact that they sink at once to the bottom of water without leaving any sensible quantity in suspension.

The constituent parts of sand represent faithfully the rocks from whence they are derived. Thus, the granite rocks produce a sand the principal ingredients of which are quartz, feldspar and mica.

The volcanic rocks are represented by sands in which lava, absidian, etc., appear.

The flat, soft-grained sands arise from the disintegration of the schistose rocks.

The calcareous rocks, as might be expected from their soft nature, are those which are least represented in the series, unless in the case of silicious sands arising from the comminution of the flints so plentiful in some of the secondary formations.

Immense formations of sand are to be found in places where rivers have long since ceased to flow. The sand extracted therefrom is known under the name of "pit sand," to distinguish it from that borne down by the rivers of the present age, called

"river sand," and from "virgin sand," which remains in the places where formed, without in any way having been acted upon by water. Pit sand is generally of a sharper and more angular grain than river sand, but in all other respects its composition is identical, excepting that it is occasionally stained by ochres.

Practically speaking, clean, sharp, coarse sand is best, and as a general rule makes the hardest plastering. It is safe to rely on river sand, the coarser the better, (within reasonable llmits.)

Lake sand is the same as river sand. Pit sand also makes good work when it is clean and coarse.

**Hair.**— Cattle hair from the tanneries is that which is most used for plastering mortar. It should be of medium length, and not too lumpy or clotted with the lime used to separate the hair from the hide.

**Marble Dust.**—this is sometimes used in hard-finishing, and should be sifted.

**Saw-Dust.**—Sawdust is used by some in mortar for the outside of walls, to guard against the action of water and frost, and prevents the scaling off of the plastering. It should be free from chips and shavings.

**Brick Dust.**—The general use of brick dust by the plasterer is as a coloring material in finishing;

it should be sifted through a fine sieve. Brick dust is also used to mix with mortar to make it set more rapidly, giving it to a certain degree the energy of hydraulic cement mortar.

**Whiting**—Whiting is used for whitewashing and kalsomining. The best quality is preferable for such work.

**Zinc White**—Is also used in kalsomining, when an extra clear white finish is desired.

**Glue**—Is used in Kalsomine and white washes. White glue is always preferable, especially when no coloring is used.

**Salt**—Is used in various washes and some mortars, coarse rock salt is the best; when used in whitewash or wall-wash it should be previously dissolved in water.

**Coloring Material**—As plasterers are often called upon to use coloring in various ways, we give below a list of those which are most commonly used: Lamp black, drop black, ivory black, powdered charcoal, red aniline, Venetian red, Indian red, vermilion, brickdust, ultramarine blue, indigo blue, blue vitriol, Spanish brown, umber, raw and burnt, chrome yellow, clay pulverized, and various colored sands for mortar.

**Brick**—Although bricklaying does not properly belong to the plasterer's trade, nevertheless it is occasionally necessary for him to do some of that kind of work when a bricklayer is not at hand; therefore we mention brick among plasterers' materials. In selecting brick for outside work, the bricks should be smoothly moulded, burnt hard, well proportioned, and of uniform color. For inside work, cisterns, etc., the principal point is to have the bricks burnt hard.

## CHAPTER III.

### MAKING MORTAR.

**Making Mortar**—Includes the slacking of the lime, and the mixing of the other ingredients with it. As we have already seen, both the process of the former and the proportions of the latter differ according to the nature of the lime to be dealt with. It is, however, a universal rule, in contradiction to the slovenly practice of some builders, that lime of whatever nature (excepting hydraulic lime in most cases should be reduced to a paste before being mixed with the other ingredients. In making plastering mortar, if the sand and other ingredients were mixed with the lime before being reduced to a paste, it would be apt to slack out and blister after being applied to the wall.

The degree of consistency of this paste should vary with the nature of the extraneous materials, and the purpose for which it is to be used. In order to secure a proper state of the hydrate it is of great importance that neither too much nor too little water be used in slacking the lime. When too little water is used the lime "burns" as the plasterers express it—that is, the lime becomes partially dry while slacking, and small particles of it fail to slack at all for want of water, and when more wa-

ter is added, the mass is chilled, these particles slack tardily, often not until after the lime is run off into the mortar bed, or sometimes even after the mortar has been applied to the wall. To say the least, these dry particles will make the mortar lumpy and cause blisters or white spots of clear ime on the wall.

On the other hand, if too much water is used, the lime is chilled, or "drowned," and thereby loses two fifths of its strength, according to some of Vicat's experiments. Too much water also retards the process of slacking, so that sometimes the smaller particles of lime do not slack until after the whole is run off, and if they happen to be small enough to pass through the screen they will slack afterward with the same result as if too little water had been used. Therefore, just enough water should be put on at first to start the slacking process and to keep the lime moist, and as the slacking proceeds more water should be added and the lime kept wet. Very fiery quick slacking lime may be kept covered with water from the start to guard against burning. The colder the water the slower the process of slacking. The lime should be stirred during the slacking after it has begun to warm up, so that when completely slacked it will be in the form of a thin paste, of about the consistency of cream. If this precaution is not taken the lime will burn in places where it is slacking fastest, and

then all the stirring that could be given to it would not take the fine lumps out of it. It should then be run off through the slats, or better a screen set at the end of the slack-box, into the mortar bed, so that the lumps or flinty sediment that may be in the lime, may be kept back.

Another method of slacking lime is in use in the manufacture of some kinds of concrete blocks, artificial stone, beaton, etc., where the material has to be rammed down solid and used comparatively dry. In this method the lime is first reduced to a powder by partially or wholly slacking, and finely sifted, as in reducing water lime to a powder, but this method is not applicable to plastering mortar, and the description of this and other methods is not required here.

For putty-coat the paste should be made thinner, like milk, before running off, and should be strained through a sieve about as fine as an ordinary flour or meal sieve. Putty will work cooler if run off the second time.

It is also important that no more mortar should be mixed up at one time than is immediately needed, or at most no more than is needed for a few days or a week or so according to the dryness or temperature of the weather; because the setting of mortar is a kind of crystallization which progresses as the hydrates give off the water which they had rendered latent, as it were, during the slacking

process; (of course this crystallization has no reference to drying mortar before it has time to set, which is often done, thus ruining the mortar); and therefore a part of the strength of the lime must evidently be lost by reworking the mortar, in proportion to the degree of advancement attained by the setting or solidifying process. And furthermore, although the pure lime gains strength by standing in the state of a thin paste, or putty, without sand or other material being mixed with it, provided it be kept moist all the time; according to careful scientific experiments it has been proved that the increase of strength of lime paste is hardly perceptible under three or four weeks, that it increases in strength for five or six months, the greatest increase being during the fourth month, the gain being then only about one-fifth the original strength of the lime; it is plain to any practical man that mortar having been mixed for so long a time with the sand in it would be considerably set, and would lose more strength by reworking and melting than it would gain by standing; and if it were hair-mortar for plastering there would be a still further loss, inasmuch as the hair would be rotted or eaten up by exposure to the action of moist lime; and the hair cannot well be mixed evenly through the mortar except while it is in the form of a thin paste, as it is when first run off, and as Vicat's experiments show, the mortar could

not be wet the second time, and made thin enough to receive the hair properly, after standing so long, without losing *two-fifths* of its strength at least.

In view of these facts, and many others, we are obliged to discard the old, erroneous notion, that plastering mortar should stand for from ten days to three weeks; years of practical experience have shown us that plastering mortar should be allowed to lie only long enough for all of the particles to become thoroughly slacked. It should then be well tempered before using.

The proportion of sand to be used varies, as might be expected, according to the nature and quality of the lime, and also of the sand itself. Thus we find that for the rich limes the resistance is rather increased if the sand varies from fifty to two hundred per cent. of the lime after it is slacked and measured in bulk, in the form of a firm paste, or from one hundred and fifty to four hundred and fifty per cent of the stone lime itself, according to the quality of the lime and the fineness of the sand. Beyond this point the resistance decreases. The resistance of hydraulic limes and cements increases if the sand is mixed in the proportion of from fifty to one hundred and eighty per cent., and from thence it decreases. It is claimed for a few varieties that they will stand considerable more sand, but the average hydraulic lime and cement will not. As no specific rule for proportions of ingre-

dients of mortar can be given to suit all kinds and qualities of lime and sand, we will simply give the principles by which we must be guided.

For the first coat on lath it is necessary to have just a large enough proportion of lime to make the mortar adhere well to the laths, and no more, and enough hair to make the clinches strong, but not enough to keep the mortar from shoving through the cracks, and clinching well; say one and one-half, or two pounds to the bushel of lime, according to the width of the cracks, or the length of the hair.

For the first coat on stone, brick, or grout, and for the second coat on lath, the mortar will bear more sand; and hair is not considered essential. When too little sand is used, the plastering is liable to crack in setting and drying, and it will crumble easily after it is dry, having an ashy appearance; on the other hand, when too much sand is used, the plastering is liable to fall off and also to crumble. The correct but varying medium can only be attained by practice and good judgment.

For the last coat, that is the putty coat or hard-finish very little sand is used, and in hard finish sometimes none at all. For putty coat it is customary to mix the sand in when the putty is run off, but for hard-finish when sand, marble dust, brick-dust or anything of the kind is used, it is generally mixed on the mortar board just before using.

The stucco is never mixed with the putty until just before using, because it sets in a few minutes after being mixed, and when once set it is useless.

Care should be taken not to use too much water, either in mixing the mortar at first, or in the subsequent tempering of it, for, as has been shown, too much water deprives the lime of about two fifths of its strength, and also retards the crystallization of the setting process.

Mortar occupies about three-fourths the space that the ingredients taken separately would occupy. According to the best experiments, the strength or resistance of good mortar, when set hard, to a force acting in a direction to tear it asunder, is fourteen pounds avoirdupois per square inch, or forty-two pounds per square inch to a crushing force, and of five and one-fourth pounds per square inch to a force tending to make the particles slide upon one another. Old work, which has been hardened by time and become more perfectly crystallized, will stand a better test. Hydraulic cement should not be mixed with water until just before it is to be used. It should be mixed with dry sand first and then enough water used to give the mortar the required consistency. The richer the lime, and the finer the sand, the more sand is required, but fine sand does not make as hard mortar as coarse sand. Fine and coarse sand may be mixed together with good results, if both kinds are clean and sharp.

Plastering hair is generally clotted with lime and requires whipping or soaking or both to loosen it up sufficiently to mix easily with the mortar. An iron rake is used to mix in the nair. The greater part of the sand is mixed in after the hair has been thoroughly incorporated with the mortar.

## CHAPTER IV.

### PLASTERING.

**Plastering**—On laths is done with one, two, or three coats, as follows: First one or two coats of brown or coarse mortar is put on, which is generally finished with a hard-finish or a putty coat. For one coat of coarse mortar hair mortar is used. It is applied to the walls with a trowel and then darbied, and after it has set sufficiently, is floated down, and if no finish coat is to be put on, it is troweled smoothly. This coat should be laid on heavier than the first coat when two coats of brown mortar are put on. When the brown mortar coat is to be frescoed it should be left under the float the same as for finishing, although fresco painting is often done on a finish coat floated instead of troweled.

If the first coat is floated too green, the float is liable to leave marks on the wall, and the plastering is also more liable to crack; on the other hand if the plastering gets too dry to float easily, water may be sprinkled on with a brush while floating. The same is true of the second coat in green work, which we speak of below. The water floating tends to harden plastering. When water is not used in floating hair-mortar, hairs will gather along the edges of

the float; and should be shaken off every few moments or they will roll under the float and the pressure will cause them to stick to the surface of the plastering in tufts and rolls, so that the work can not be smoothly troweled; if a finish coat is to be put on the hair will show through the finish, giving the wall a very unsightly appearance.

In "green work" a leveling coat of brown mortar without hair is run on over the first coat while quite green, before moving the scaffold, and then the whole is darbied, and dealt with as one single coat, the two setting together and uniting as inseparably as one coat, and has the advantage of sandier mortar on the surface than could be used in one coat, and also of drying slower than "dry work." In the Western States this method is gaining favor, and makes very good plastering when floated at the right time, and not dried too rapidly.

In "dry work" the two coats of coarse mortar are put on as follows; and when finished with a hard-finish or putty-coat it is called "three coat work:" The first coat is hair mortar. It is put on the ceiling first, then on the sides as low as the scaffold, and then on the bottoms as in the case of one coat work, but not quite so heavily; it should be well scratched and not darbied nor floated. Care should be taken to put it on evenly. This coat is called the "scratch coat," and should stand until perfectly dry before the second coat is put on. In this kind

of work, in no case should the second coat be put on until the scratch coat is perfectly dry, for then the second coat will adhere to the first as it would to brick or stone; but if the second coat be put on when the scratch coat is only partially dry, the two coats will not stick together, but will soon separate, and the greater part of the second coat will fall off, and, as the second coat will never set so well, nor be so hard when put on in that way, the remainder of it will be very apt to soon crumble off, and furthermore, when the scratch coat is only partially dried and partially set, it is neither tough nor hard, and it will not stand the floating etc. without being injured, and it often becomes loosened from the laths, the clinches become broken, and as a natural consequence it *all* falls off together, carrying with it, of course, the third coat, if there be any. Poor workmen still blindly persist in putting on plastering in this way, and wonder why it falls off; generally laying the blame to the materials used. Whereas three coat work, when properly done, is the very best kind of plastering.

When the scratch-coat is dry the second coat, which is called browning, should be laid as follows; first, if very accurate work is required, spots of brown mortar the required thickness of the plastering, are put on the wall at the base, close to the angles, and, if the rooms are high, at about half the height, or once in six feet, and in perpen-

dicular lines with those at the top and bottom; if the rooms are large, several perpendicular rows of spots are put on each wall at convenient distances to correspond with the length of the common straight-edge. These rows should be plumbed with the "long rod" with a spirit plumb inserted in it, and the surface of all the spots on the same wall should be made to lie in the same plane. These spots should also be floated, and if no finish is to be put on, should be troweled. Any time after the spots are set hard, screeds of mortar are put on in horizontal lines with the spots; the screeds should be darbied and floated; the rest of the wall is then filled up even with the screeds and spots, straightened with the straight-edge, darbied, floated, etc., in the same manner as the screeds. If no finish coat is to be put on, the whole surface is to be troweled smoothly as the work goes on, leaving no "cat-faces," (hollows, or uneven places not well filled out); but if the wall is to be finished or frescoed, it should be left under the float.

Only as large a surface should be covered at a time as can be darbied, floated, etc., before it has time to set. In ordinary work the spots may be dispensed with, as the screeds will make the wall accurate enough if they are put on straight. The first screed should be put on at the base, and the next the length of the straight-edge above it, or at a convenient height to correspond with the height

of the workmen, or the middle row of spots if such there are.

After browning the lower half of the walls, the scaffold should be put up, and the screeds and browning should be put on the ceiling and then on the upper half of the walls.

We would recommend water-floating this kind of work, for it makes a harder surface, though it may take a little more time.

Cement may be mixed with the brown mortar for the second coat if very hard walls are desired, but it should not be mixed until ready for use.

Stucco (Plaster of Paris), is sometimes used in the scratch coat for ceilings, to make the mortar set rapidly and hard. When stucco is thus used the mortar should be "gauged" with the plaster after it is placed on the mortar board, and the scratcher should be used before the plastering sets.

The finish coat should not be laid until the brown mortar is dry and hard, because it would be liable to crack if it was put on sooner, besides the danger of injuring the brown mortar work with heavy troweling when it is partly dry.

A simple putty-coat should have more sand than a hard-finish. Hard-finish should be gauged, (that is should have the plaster mixed with the putty) after the putty is put on the mortar-board. In gauging the putty it is customary to make a hollow with the trowel in the middle of the pile of putty

on the mortar-board; the hollow should be large enough to contain the water and plaster—say from twelve to sixteen inches in diameter for common-sized gaugings, and should be made clean to the board, leaving no putty on the bottom, but placing it in the form of a ring around the outside of the board. Then the water should be poured in, and the plaster sprinkled into the water, the whole mass mixed rapidly with the trowel and hawk, and applied to the wall or ceiling as rapidly as possible, before the plaster has time to set. The proportion of lime and plaster vary with different work, but the average is probably one-fourth or one fifth plaster.

The finish is usually skimmed on in two very thin coats, one right after the other; but some plasterers prefer to skim three times; and the finish is then only about as thick as an ordinary thin pane of window glass. It is then immediately troweled several times over with a trowel and wet brush, to prevent chip-cracking and to give it a smooth surface. If too little water is used in the process the steel trowel will stain the finish, and if too much water is used it will "drown" or "kill" the plaster, causing it to peel.

After troweling, the whole surface should be brushed with a wet brush once or twice, and if a "buffed" (polished) surface is required, it should be again brushed without dipping the brush into

the water until a polished glossy surface is obtained. Care should be taken to finish all joinings so that they will not show.

Angles may be finished with the wooden paddle; as in hurried work the trowel is apt to cut into the angles.

Ceilings should be finished first, then the upper part of the walls, and then the bottoms. Sometimes the walls are finished top and bottom, at once —one man doing the upper part while another is doing the lower; or in very high rooms, several men work together, one above the other, on scaffolds about six feet apart in the clear. This is to avoid dry joinings in the finish.

Putty-coat is trowelled and brushed the same as hard-finish.

In plastering on stone, brick, or grout a scratch coat is seldom put on. Only one coat of brown mortar is used and that generally without hair; the work is rendered about the same as second coat in dry work on laths. Where a scratch coat is used on brick etc. it is about the same as first coat on laths, except that it has more sand and less hair. The finish is the same as on laths.

In plastering on external walls the second coat should be all or part cement: equal parts lime and cement will do very well. If the wall is exposed to the alternate action of water and frost, sifted sawdust mixed with the mortar, will in a great

measure prevent the scaling off of the plastering so commonly noticed on such walls. Plaster of Paris will not withstand the action of the weather and therefore is not reliable for external work. Plastering on external walls in very dry, windy weather should be frequently sprinkled with water, to prevent too rapid drying, which injures the setting of the mortar even if made of fat lime, and to a much greater extent when made of cement. All plastering in damp places should be done with cement instead of fat lime.

Plastering with cement is generally similar to browning. The work must be done rapidly, and only as much mortar should be mixed at a time as can be used before it begins to set. Cement floors are made by running a screed around the margin and levelling the whole floor by the screed. Gravel, brick, stone, or even hard clay will make a good base to cement on for a floor.

**Back-plastering**—Consists in lathing and plastering between the studding against the outside sheeting of frame houses. It is done with one coat of hair-mortar, and should be allowed to dry before the lathing is placed on the studding.

## CHAPTER V.

### PRACTICAL SUGGESTIONS AND PRECAUTIONS.

In running off the mortar it is well to have a supply of sand all ready screened, to scatter in the bottom of the mortar bed, and to use to stop leaks that may start in the bed after some of the lime has been run off, and also sand enough to make the mortar with, so that no time will be lost in stopping to screen sand. There should also be a good supply of water constantly on hand while slacking lime, to avoid the danger of burning the lime.

The mortar bed should be made with a close bottom and strong sides, well staked or braced, so that no leak can start.

When convenient, it is a good plan to put the hair to soak the day before the mortar is to be made, as it will separate and mix so much easier, and it saves the dusty and unhealthy work of whipping the hair.

In making mortar laborers are apt to stop adding sand before enough has been put in, simply because it is hard work to mix the sand into a batch of mortar after it becomes a thick paste. This should be guarded against; for it is much harder to mix it in a day or two later, when the tempering is done, and

may cost the contractor the wages of an extra hand, to do the extra work so caused. Again, we are annoyed by laborers who do not half do their work, leaving the bottom and corners of the bed only partially mixed, leaving lumps of clear lime that will harden more than the rest of the mortar when shoveled out, and then when the mortar comes under the hoe of the man who tempers, some of these lumps may pass unnoticed, until they are flattened out under the trowel of the plasterer. Then comes a further loss of time in picking them out; for clear lime will not make a hard wall. It is also a waste of material.

Another annoyance is poorly screened sand. The gravel in the mortar not only retards the progress of the workmen while plastering and floating, but also wastes a great deal of good material, as one little gravel stone often throws a whole trowel-full of mortar to the floor, often among rubbish from which it cannot be saved.

**Cracks in Plastering**—First, if the coarse mortar is too rich, it will crack in drying; such cracks generally run lengthwise of the laths. Similar cracks are often caused by drafts of air from open doors and windows, which dry the plastering too fast. Another cause is too rapid drying with stoves or salamanders, even when the mortar is not too rich. These cracks look alike, and require a knowl-

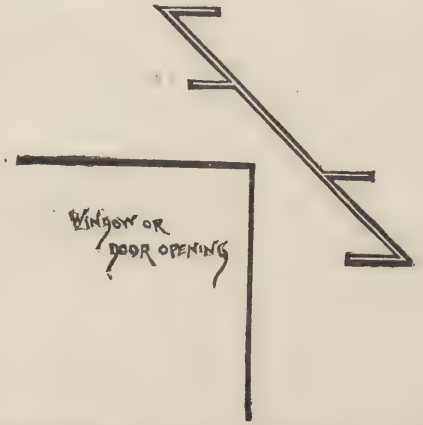
edge of the cause in order to prevent them; and of course the remedies are: if the mortar is too rich, use more sand. If from a draft of wind, close the opening through which the wind comes. If from a stove, use less fire, and if cracks occur in green work before it is dry, float it again, using water if necessary. Cracks in the angle at the ceiling may be caused by settling of the partition wall and floor below, or they may only extend through the finish coat, as is sometimes the case with the perpendicular angles. When that is the case, the cause is one of three things, viz. too great a thickness of putty-coat, too little troweling, or too little plaster in the gauged stuff; in either of which cases the remedy is self evident. The coarse plastering should be straight enough so that the thickness of the finish coat need not be increased nor diminished in order to straighten up the work.

But if a little filling-in is absolutely necessary to straigten the work, use plaster and putty half and half, then cover the whole with the finish coat.

A crack will occasionally appear at the end of a "break" of laths on the joist or studding. This is generally caused by the ends of the laths not quite meeting, making too great a thickness of plastering there, and it cracks while drying. It is the lather's business to fill all such spaces with pieces of lath.

Cracks are frequently noticed running diagonally

across the partition, or as radiating from the corners of doors and windows. The cause is settling and springing of parts of the building; The cure is better foundations and more solid carpenter-work. Diagonal braces halved into the studding of the partition walls and passing close to the corners of the doors and windows, and other weak points, are great helps. In brick walls an iron brace of this form anchored into the inside of the wall at each door and window corner has been tried with good results




"Chip-cracks" occur in hard-finish when the putty is not gauged high enough, and when it is not troweled enough and also when it is put on too thick.

A common putty-coat chip-cracks when put on

too thick, when not troweled and brushed enough, and when there is too little sand in it. The causes suggest the remedies.

In green work care should be taken to float the browning at the right period of the drying, for even good mortar is liable to crack when it is floated too soon, about as it would if not floated at all; and on the other hand if it is allowed to become too dry there is danger of applying too much pressure and springing the laths, thus loosening the plastering as well as cracking it.

**Crumbling and falling off of Plastering**—We frequently see plastering that looks very nice on the surface, and has no cracks in it, but when touched with any hard substance a hole is easily made in it, and the plastering will run out upon the floor like sand, and pieces of it, if knocked off, crumble very easily. Sometimes this is caused by two rapid drying. Plastering should always dry slowly, for lime must have time to set while there is some moisture in it, and if it has dried before, it will have about as much strength as a lump of dried mud.

When mortar is made too poor with the use of too much sand, it will crumble.

Either extreme, in the amount of sand used, when carried beyond certain, but varying limits, will reduce the strength of the mortar. Another

cause of weak and crumbling plastering is the use of sand with loam in it. For the crystallization of lime requires not only a certain degree of moisture, to assist in starting the process, but also some hard solid substance for a nucleous around which the crystallization or setting begins. Each grain of pure sand serves as a nucleous from which the setting spreads. But when dust and dirt is mixed with the sand it not only weakens the lime, but separates it from the sand so that the setting can not go on perfectly, and the result is that the mortar only dries and does not set. An abundance of clay in the sand has a tendency to make the plastering crack, as well as crumble.

Poor lime is another cause of weak plastering. All these and many other things must be taken into consideration.

Experience and close observation are necessary to guard against the many failures and difficulties in securing good plastering. Sometimes when the brown coat is hard and good, the whole plastering falls off. This may happen in several ways: the first coat may be too rich, or two sandy, or may not have enough hair in it to hold the clinches, or the laths may be too close together making the clinches small and weak, or the mortar may not have been pressed against the laths with sufficient force to form a perfect clinch, and at the same time may have been floated too hard and loosened

from the laths by springing them with the pressure. Any of the above mentioned causes would have about the same effect, except that on brick work the reason is generally that the mortar in the first coat is too rich, too stiff, or made of poor materials. Mortar for plastering on brick requires much more sand than the first coat on laths.

Occasionally plastering is loosened by water being spilled on an upper floor, or coming through a leaky roof.

Freezing is more injurious to the surface of fresh plastering than to the first coat, still it loosens up and injures the whole mass so that it generally falls off.

If the wall is frozen dry it will not do so much damage as if frozen and thawed. If only slightly frosted, and floated again as soon as thawed, it can often be saved.

Stiff mortar makes better and harder plastering than thin, wet mortar; but it must be thin enough to clinch well on laths, and adhere well to brick work or dry scratch coat, and to spread well as second coat on green work.

Wide lathing will take stiffer scratch-coat mortar than close lathing, and wet brick will take stiffer mortar than dry brick.

When two coats of coarse mortar are put on, and the second coat separates from the first, leaving the scratch-coat on the wall, the reason is generally this: The scratch coat has been put on and

allowed to get about half-dry and then the browning has been laid. That kind of plastering never makes good work, for the two coats will not cement together when the first coat is about half-dry. Plastering should be either, "*dry* work" or "*green* work;" no mongrel work will pass muster. If the first coat is quite dry when the brown coat is put on it will adhere to the first coat as it would to brick, especially if the first coat has been well scratched. Or if the first coat is quite green the two coats will unite as one: and in either case, (everything else being right), the plastering will be good.

This half-way plastering is generally done by bad workmen who are either novices at the business, or, what is worse, old fogies who claim to have been plasterers for forty or fifty years; men who have never learned the trade but who have perhaps *daubed* the mortar on two or three houses in that length of time, or may possibly have repeated the outrage on a dozen or more buildings, or may only have made mortar a few times; but at most their experience is no comparison to that of the workmen who plaster their thousands of yards year after year for even a much less period.

Some of these men want mortar to be made very rich; others want it nearly all sand. Some of them think that but very little hair is necessary; others want it about half hair. Some want very close lathing; others want the laths about three quarters

of an inch apart; etc. etc. This class of men succeed in convincing many that their false opinions are right, calling attention to their age and *experience* (?) to prove that they must be correct.

We have been annoyed by such men so much that we thought it well to call attention to them.

Good workmen sometimes make mistakes, especially with materials that they are not acquainted with; but as a rule their work will be good if no accident happens to it.

In the finish coat we often see little raised spots that look like blisters. These are generally caused particles of lime that were not slacked before the mortar was put on the wall, after which they slack and bulge out, giving the wall a spotted appearance. This happens mostly with coarse mortar, and can be prevented by slacking the lime thoroughly and straining it well. If it is either drowned out, or burnt in slacking it will be difficult to keep out the lumps; if they get into the mortar it will be next to impossible to grind them all out with a hoe, and they will be found, as before mentioned, in the wall.

Blisters on hard-finish are often caused by trowelling with too much water. When the brown mortar is a little green the finish is apt to blister. Too much water will sometimes cause the finish to peel, and too little water will cause the steel trowel to stain the finish, especially if the trowel is not tempered very hard, or if held too flat while trowelling.

## CHAPTER VI.

### Cisterns.

We give this short article on cisterns because plasterers are so often called upon to build, and repair, as well as to plaster them. Therefore a few hints will not be amiss,—to the inexperienced, at least.

Cisterns are made in various ways and of various forms.

For a very cheap cistern, a hole is dug in the ground and plastered, without walling up, provided the soil is hard enough to hold the cement; and when made quite small they sometimes last a long time made in that way. But when something more substantial and durable is required, the walls are usually made of stone or brick. As stone is heavier than brick and does not generally break joint as well, it is more apt to settle and crack, and being rougher, requires more cement to plaster than the same surface of brick wall. As a rule hard burnt brick is considered the best material for cistern building. Common cistern walls are generally laid in fat lime mortar, but cement is decidedly better, and is almost invariably used for works of much importance.

Cisterns are plastered with mortar made of one part cement, to from one to three of sand. Usually one of cement to two of sand. Two coats are generally applied, and sometimes three, waiting for each coat to partially set before applying the next. Then the last coat is brushed with a wet brush while it is green which assists in hardening the cement.

**Filters**—In cisterns are made in many different ways; sometimes fixed at the top, where the water is let in, sometimes it consists of a partition wall built, dividing the cistern in two compartments, the water being let into one compartment and taken out of the other, holes being left at the bottom for the water to pass through the partition. The gravel, sand and charcoal, or marble-chips and charcoal, which are used to form the filter, are filled in, in layers, to a height above the holes in the partition on the side in which the water is admitted. The partition should be plastered the same as the rest of the cistern. Another similar filter is made by laying a brick party wall in cement, with no holes through it, but this partition should not be plastered, the water being filtered through the bricks. This kind of filter clogs up in the course of time, and becomes useless.

Another cheaper and more effectual filter is made as follows; a small arched mound of brickwork

about a foot high is built on the bottom of the cistern in the lowest part. The pump pipe is cemented into the top of this hollow mound, and small holes are left around the bottom, for the water to pass through. A circular brick wall is built around the mound, about four inches out from it, and about three or four courses in height. Then this space between the circular wall and the mound is filled with the filtering material, which is put in, in layers; the first and last layer should be clean gravel or marble chips or small spalls of other stone.

The arch or mound of the filter, as well as the whole cistern, should be plastered before the filtering material is put in. In filling the filter the second layer of charcoal should be powdered. In repairing cisterns, when the cement is cracked, the cement should be cut away an inch or two wide, all along the crack, in order to give a sufficient body of new cement to hold; otherwise it would crack a gain in the same place.

When veins of water force their way through newly plastered cisterns from the outside, the leak can be stopped and the cement set by pressing a hot brick against the fresh cement.

As the most common form for a cistern is that of a cylinder, we give below a table of dimensions and capacities of cisterns of that form.

When the cistern is a cylinder on end, with an arch at the top, add one-third of the depth of the

arch to the depth below the arch for the total depth. If the diameter varies all the way, take the average diameter by the depth for the contents. For a greater depth than is given in the following table, multiply the contents of one foot in depth by the total depth, (in feet), of the cistern, for the contents of the cistern.

The numbers at the top indicate the feet in diameter, and the numbers in the margin at the left indicate the feet in depth; the other numbers, the barrels contained.

*Table of Dimensions and Capacities of Cisterns.*

| Depth in Feet. | 4 feet Diam. | 5 feet Diam. | 6 feet Diam. | 7 feet Diam. | 8 feet Diam. | 9 feet Diam. | 10 feet Diam. |
|---|---|---|---|---|---|---|---|
| 1..... | 3.33 | 4.70 | 6.74 | 9.18 | 11.99 | 15.20 | 18.74 |
| 2..... | 6.66 | 9.40 | 13.48 | 18.36 | 23.98 | 30.40 | 37.48 |
| 3..... | 9.99 | 14.10 | 20.22 | 27.54 | 35.97 | 45.60 | 56.22 |
| 4..... | 13.32 | 18.10 | 26.97 | 36.72 | 47.96 | 60.80 | 74.96 |
| 5..... | 16.65 | 23.50 | 38.70 | 45.90 | 59.95 | 76.00 | 93.70 |
| 6..... | 19.98 | 28.20 | 40.44 | 55.08 | 71.94 | 91.20 | 112.40 |
| 7..... | 23.31 | 32.90 | 47.18 | 64.26 | 83.93 | 106.40 | 131.18 |
| 8..... | 26.64 | 37.60 | 53.82 | 73.44 | 95.92 | 121.60 | 149.92 |
| 9..... | 29.97 | 42.30 | 60.66 | 82.62 | 107.91 | 136.80 | 168.96 |
| 10..... | 33.30 | 47.70 | 67.40 | 91.80 | 119.90 | 152.00 | 187.40 |
| 11..... | 36.33 | 51.70 | 74.14 | 100.98 | 131.89 | 197.20 | 206.14 |
| 12..... | 39.96 | 56.40 | 80.88 | 110.16 | 143.88 | 182.40 | 224.88 |

## CHAPTER VII.

### ORNAMENTAL PLASTERING.

**Mouldings**—Are made as follows: For cornice mouldings, two plaster screeds are run with the trowel, and straightened with the straight-edge, and trowelled smoothly, one on the ceiling and the other on the side walls, at the proper distance from the angles for the shoes of the moulds to slide upon them. Then thin wooden screeds are nailed to the walls for a guide, upon which the lower shoes of the mould slide. These wooden screeds must be carefully adjusted, so that the mould will run in a straight line. Where very heavy members of the moulding occur, rows of nails may be driven to help support the cornice, being careful to drive them in far enough to clear the mould as it passes over them. The laths are generally left bare in the angles so that the gauged stuff will clinch through between them; and if the angles have been previously cut by plasterers cut the plastering away to the width of the moulding.

Everything being ready, enough putty is gauged with about an equal part of plaster, to run a strip of moulding of convenient length, say one side of

an ordinary room, beginning a foot or so to the right of one of the perpendicular angles and going toward the left to within about the same distance of the next angle. Then the angle next to the ceiling, where the cornice is to be run, is filled with the soft, gauged stuff by throwing it into the angle with the trowel, until the moulding is nearly filled out, or until the gauging is used up; then the mould is run over the whole length of the piece thus prepared, cutting away all the gauged stuff except the moulding. This should all be done rapidly, as the gauged stuff sets in a few minutes. After running the mould over the first time, the gauged stuff thus scraped off with the mould, should be at once used again to fill out places in the moulding where most needed, and the mould run over the moulding again. Then more stuff is gauged and the process is repeated several times until the moulding is filled out, after which the moulding should be sprinkled with the brush and the mould run over it once more; then finish with a brush to give a gloss, and go to the next piece of cornice and proceed as before.

If a mitre-mould is not used, the mitre must be filled out by hand with the mitring rod and other small tools made for that purpose; but the mitre-mould works much easier and saves a great deal of time. It has been described in the chapter on "Tools used" Circular and elliptic center mouldings are run from a center with the mould attached

to the arm working on the center, or trammel, and sliding on one circular or eliptic screed, as the case may be. For a circular moulding a gaspipe or a temporary pin may be used for a center. Arch mouldings etc. are made in a similar way. For elliptic mouldings a trammel of the following description is used: Two pieces of wood are halved together at right angles to each other; with grooves cut the whole length of each piece, and intercepting each other at the center. (see illustration in paragraph on "Trammels" in the chapter on "Tools Used.") The length of these two cross-pieces should be equal and a little less than the short diameter of the required ellipse. The arm of the mould used for the ellipse is the same as that used for a circle, except that it has two pins in the arm to slide in the grooves in the trammel, one pin being placed in the inner end of the arm; the other pin is put farther along the arm, close to, or farther from, the end pin, according as the ellipse is to be broad or narrow. These pins should just fit the grooves in which they are to slide. The distance of the end pin from the mould will equal half of the long diameter, and the distance of the other pin from the mould will equal half of the short diameter. Niche, and panel mouldings are run by screeds or trammels as the occasion may require.

Cast centers, rosettes, brackets and other such ornaments are made in moulds which are put to-

gether in sections, with an orifice into which to pour the plaster, which is made thin like gruel, no lime being used. Bass-reliefs are made in open moulds all in one piece. These moulds for casting should be oiled before using. Most of these moulds are made of plaster hardened with glue or shellac, but moulds for bass-reliefs are often made of beeswax. Plaster ornaments are fastened up in their places with fresh plaster, and sometimes a few screws to help hold the heavier ones. When screws are used the heads should be countersunk and covered with plaster so that they cannot be seen.

## CHAPTER VIII.

### MISCELLANEOUS.

**Lathing**—In common lathing the spaces between the laths should be one-fourth of an inch, which allows for shrinkage. If made less than that the clinches will be too weak, and if much more they will sag down on the ceilings, and drop off with their own weight on the sides ; and in no case should the spaces exceed two-fifths of an inch, except where the furring is very thin like strips of lath nailed on the inside sheeting, or ceiling, or where the laths are very dry and well seasoned. Most lathers break joints about every six laths, that being a convenient sized handfull to pick up, and some break joints every tenth, but every other lath is better. The studding should not be over sixteen inches apart, twelve inches is still better. Lathing is estimated by the square yard, and is measured the same as plastering, without deducting openings for doors, windows etc. except when the opening exceeds sixty-three square feet.

Many people think that very large lath nails are indispensable ; but experience shows that with common sized lath nails the laths seldom fall off, and even "three-penny fine" nails hardly ever pull out,

without some force greater than the weight of the laths and plastering.

In driving the nails, one light blow to start each nail, and another heavier one to drive it in while reaching to your mouth for the next nail is all that is necessary.

**Chimneys**—The object of a chimney flue is a safe and efficient means of carrying off smoke, hot air, etc. Therefore security is the main point inside of the building. In order to attain that end the flue must be as straight as practicable, thereby securing a good draft, preventing soot from collecting and frequently burning out. The flue should also be built strongly, filling the joints carefully with good mortar to prevent cracking.

Outside, symmetrical form and clean work are essential features.

Five courses of brick will lay up one foot in height, mortar joints included. Hard brick should always be used.

**Whitewashing.**—In order to do good whitewashing it is necessary to have a good brush, and good wash. These two being supplied, and a suitable scaffold being ready, dip the brush into the wash about half the length of the bristles, and then brush as much of the wall or ceiling as that amount of wash will cover, wetting it thoroughly; then finish by passing the brush once over the strip

just put on, and immediately dip and repeat the process upon an adjoining piece of the wall or ceiling. Avoid dry joinings, and be careful not to spatter. One coat is not generally enough to whiten old plastering.

Another method is to brush in any and every possible direction, instead of finishing by brushing all one way. This seems to give it more of a solid appearance.

**Whitewashes**—1st. *Wash for fences*— One-half bushel lime slacked to putty; two pounds zinc-white, dissolved in water; one pound common salt dissolved in water. If color is wanted, color to suit, and set the color with one table-spoon of powdered alum. 2nd. *Wash for wood, brick, stone or plastering*—Slack about one peck of lime in hot water, keeping it covered to keep the steam in during the slacking; strain and add one half peck of salt dissolved in water; one and one half pounds off ground rice, put in boiling water and boiled to thin paste; one-quarter pound powdered whiting; and one-half pound white glue dissolved in water. Mix well together; let stand for several days, and apply hot. Color to suit. Coloring mixes better before the glue and paste are put in. 3d. *Another*— Fifteen pounds of whiting, and one-half pound fresh slacked lime dissolved in skim-milk. Color to suit. This wash becomes as hard as paint.

**Kalsomine.**—To fifteen pounds of best whiting dissolved in cold water, add one pound of clear, white glue dissolved in warm water. Apply cold except in cold weather when the walls are all cold, then it is well enough to use some warm water, enough to keep the mixture thin so that it will spread easily. To dissolve the glue, first cover it with cold water and let it stand and soak until it becomes soft, then pour off the cold water and add hot water: it will then readily dissolve. For very fine work use zinc-white instead of whiting.

One-half ounce of ultra-marine blue added to the above makes a clearer white. Color to suit before putting in the glue. Apply the same as the second method mentioned for whitewashing.

**Cheap Paint.** — Hydraulic cement and skim milk. Color to suit. Is not white.

*Another.*—Eleven pounds of dry slacked lime sifted fine, one gallon water, one gallon linseed oil, (raw or boiled), one half pound potash dissolved in water by heating over the fire. First mix the lime and water, then add the oil and potash. If the oil does not unite with the water, add a little more potash water, but only enough to cut the oil. Color to suit.

**Granite Finish.** Brown ground-work spatter first with white, then half as much with black, then as much with red as with the white. Used on outside

work, it requires to be penciled to represent blocks of stone.

**Stucco Plastering.**—Three or four bushels of fat lime to one bushel of hydraulic cement, with sand, six or seven to one.

**Blackboards.**—If on laths, plaster with three coats as follows: Scratch-coat of good hair mortar, gauged with Plaster of Paris. When dry brown with a coat of browning made with half as much cement as lime. When that is dry, finish with a good coat of hard finish, colored black with lamp-black dissolved in alcohol; when the finish is dry apply two coats of liquid slating made as follows; one pound white shellac, one half pound powdered pumice-stone, one-quarter pound lamp black, dissolved in one gallon pure alcohol. If the black-board is to be put on a stone or brick wall, the scratch-coat may be omitted. Warranted to give satisfaction.

**Tucking.**—The tools used for tucking are a long and a short straight-edge, sometimes with spirit plumb-bob and level inserted; a hawk eight inches square with handle on one corner, and a brad in the opposite corner, with which to hold the straight-edge; and the tucking tool. The mortar is generally made with fat lime and white sand, and a little cement, and is used very stiff. The staining, if any, must be done before the tucking.

**Hydraulic Mortar.**—Is made with one part blue Lias lime to two and one-half parts burnt clay, ground together.

**Beton.**—One part hydraulic mortar to one and one-half parts of angular stones.

**Concrete.**—One part lime, two parts sand, and four parts gravel. Also one part lime, one part cement, two parts sand, and four parts gravel. Or four parts cement, three parts lime, sixteen parts sand, thirty-two parts broken stone, or gravel, three parts water. Slack the lime a few days before hand.

**Grout or Gravel Houses.**—To eight barrows of slacked lime add fifteen barrows of sand. Mix to a creamy consistency, and then add sixty barrows of coarse gravel; mix well together. Throw in as many stones as desired, not to exceed ten inches in diameter. The proportion of lime, when very rich, can be slightly diminished.

**Gravel Walks.**—Fifteen bushels of gravel, from three to five bushels of sand, and from one, to one and a half bushels of lime. Coarse gravel requires more sand.

**Mastic Water-proof Cement.**—One part red lead, four parts ground lime, five parts sharp sand mixed with boiled oil; or one part red lead, five parts whiting, ten parts sharp sand, mixed with boiled oil.

**Marble Finish.** — Hard-finish with dissolved lampblack, spattered on it in streaks with a pencil-brush just before troweling. The trowelling will blend the streaks of black, making them resemble the seams or grain of marble.

**Measurement of Plastering.**–Plastering is generally measured by the square yard, and, according to custom, no deduction is made for doors, windows, and other openings which do not exceed sixty-three square feet. In measuring closets it is customary to add half of the contents, and if the shelves and strips are in before plastering, double the contents. Small gables and other triangular pieces are counted square. These extra allowances are made to make up for the extra labor of plastering such pieces of work.

**Comparison of Measures.**—One bushel equals 2150.42 cubic inches; one gallon equals 231 cubic inches; six and five-tenths barrels equal one cubic yard; one load of earth equals 21.7 bushels.

**Table of Weights of Materials.**—The following shows the weight (avoirdupois) per cubic foot of various kinds of material; average mortar, 106 pounds; water, 62½ pounds; loose earth 95 pounds; common soil (compact), 124 pounds; clay (compact), about 135 pounds; clay with stones, 160 pounds; brick, 125 pounds; lime, 64 pounds; sand, (loose), 96 pounds

And the following shows the bulk of one ton of different substances in cubic feet: Sand, 28 cubic feet; earth, (compact), 18 cubic feet; earth, (loose), 32 cubic feet.

**Bill of Material for One Hundred Yards of Plastering—Three Coats.**—Eight bushels lime, one bushel hair, one load sand, one quarter barrel plaster, fifteen hundred laths, and five pounds of nails. This of course varies somewhat with the quality of material. About two bushels of lime are required for the finishing, the other six for the coarse mortar.

**How to Find the Area of an Ellipse.**—Multiply the long diameter by the short diameter and by the decimal .7854. The product will be the area. Or multiply one-half of the long diameter by one-half of the short diameter, and that product by 3.1416.

**How to Find the Area of a Circle.**—Multiply the square of the diameter by the decimal .7854; or multiply the circumference by the radius and divide by 2; or divide the circumference by 3.1416, or $\frac{355}{113}$; or square half the diameter, and multiply it by 3.1416 or $\frac{355}{113}$; or square half the circumference and divide it by 3.1416 or $\frac{355}{113}$; or multiply the circumference by $\frac{1}{4}$ of the diameter.

**To Find the Circumference of a Circle.**—Multiply the diameter by 3.1416 or $\frac{355}{113}$.

**Miscellaneous Table.**—The average weight of one bushel of mortar is $131\frac{1532}{1728}$ pounds. The average weight of one bushel of sand is 120 pounds. The standard weight of one bushel of lime is 80 pounds. The standard weight of one bushel of hair is 80 pounds. Hardened mortar weighs 110 pounds per cubic foot. One barrel of Rosendale cement weighs about 300 pounds. Portland cement weighs about 400 pounds to the barrel.

## FORM OF CONTRACT.

**Contract for Plastering,** made this....day of....., one thousand eight hundred and...., by and between..... of....., in the County of....., and State of....., and.....of...., in the County of....., and State....., Plasterer:

Witness that the said....covenants and agrees, to and with the said....to plaster in good, substantial and workmanlike manner, the following described building: (Here describe the building.)

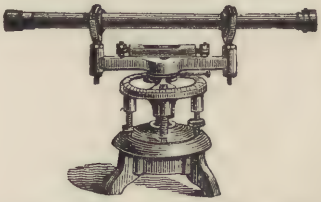
Said plastering to be done with....coats, and finished in the following manner.....; and completed on or before the.... day of ....next. In consideration whereof said....covenants and agrees to pay said....the sum of....dollars, as follows; ..... And for the performance of all the agreements above mentioned, the said.... and .... do hereby bind themselves, their heirs, executors and administrators, each to the other in the sum of....dollars, firmly by these presents.

In witness whereof we the said....and....have hereto set our hands the day and year first above written.

| | (Signatures.) | (Seals.) |
|---|---|---|
| Executed and delivered in presence of ..... | } | } .... } .... |

The above form may be varied to suit every case.

# An Improved Leveling Instrument.



**Price of Instrument Complete, $20.00.**

Adapted to the use of Architects, Engineers, Masons, Builders Farmers and others.

This instrument is made of Brass and Iron, furnished with both masons' (short metal) and surveyors' tripod. Put up in handsome wooden box with strap. The only low priced Level that can be thoroughly adjusted in the field.

**A New Leveling Rod.**

This rod is round and made in two sections; is united by a solid screw joint, as if of one length, and has a target. There are two scales' one side being Engineers' (feet, 10ths and 100ths), the other Architects' scale (or, feet inches and 8ths).

**Price, - - $6.00.**

*Forwarded by express on receipt of price. The charges of transportation from New York to the purchaser are in all cases to be borne by him, I guaranteeing the safe arrival of all instruments to the extent of express transportations, and holding the express companies responsible to me for all losses or damages on the way.*

*Where the Level is ordered with the Rod, the price of the two will be,* - - - - - - - **$25.00**

**Circular on Application.**

WILLIAM T. COMSTOCK, Publisher,
**6 Astor Place, New York.**

## Catalogue of Books for Masons and Builders on application.